

THE STRUCTURE OF THE NESTS OF SOME NORTH AMERICAN SPECIES OF FORMICA.

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A few years have elapsed since Professor Auguste Forel made a myrmecological tour through some of the eastern states. A short synopsis of his results was communicated by him from Faisons, N. C., to the Belgian Entomological Society, Brussels. In the very beginning of this report, which is doubly valuable, emanating as it does from the pen of a man so thoroughly acquainted with European ant-nests, Prof. Forel expresses his astonishment at the remarkable and characteristic structure of the nests in America. "In North America," he says, "with some rare exceptions, the ants do not construct mounds, either of masonry or of other materials." (*Psyche* vol. 9, No. 304-305, p. 231.)

The purpose of the following remarks is both to prove by new facts this well-founded statement and to modify it with reference to southwestern Wisconsin. The facts presented will serve at the same time to illustrate in accordance with local circumstances his interesting "theory of domes."

For the sake of clearness I propose first to examine the *exterior structure* of the nests and then to pass over to their *interior arrangement*.

In the first place, to avoid misunderstandings, we must be on our guard, lest by an American "ant-hill" we under-

stand something similar to what is meant by Forel and Wasmann when speaking of the ant-hills of Switzerland or Holland. To say the least, ant-hills in this country never have a height and circumference approaching any of those of Europe. I remember well myself to have seen in western Germany, for instance in the Eifel and in Munsterania, ant-hills reaching a height of 1 m. Besides, there can be no question concerning the fact that the less conspicuous ant-hills of America do not even occur as frequently as they may be found, for instance, in the fir plantations of southern Holland. Still it would be a decided exaggeration to apply to this region the remarks of Forel concerning the eastern states. "When conversing with them (Americans) they refer to it (ant-hill) as a great rarity which can be found in such and such a forest twenty or thirty miles away" (*l. c.* p. 231). Here within a radius of five miles I know of at least one hundred so-called ant-hills. The reason for this may be found in the circumstance that hereabouts the ants are subject to less disturbance. In any case, it remains an established fact that ant-hills are far less numerous here than in Europe.

The ant which really erects regular hills is precisely a species not occurring in the east, as Forel justly remarks,

namely *Formica obscuripes* For. It is one of the most ferocious ants to be found here and to it alone may be applied his remarks concerning *Formica integra* Nyl. in the east, namely that like the European *F. pratensis*, it "rises upon its hind legs, curves the abdomen and ejects . . . some venom while in this position" (*l. c.* 233). According to my experience the ejection of formic acid is so copious, as to force the observer to retire momentarily, especially during the main breeding season. Of these ants I know at least 35 nests in this neighborhood. All without exception consist of elevated conical mounds, whose shape is more or less modified according to its age and the number of inmates. I had occasion to observe the nests as well in their inception as in the different stages of their development. In founding a new colony this species, unlike many of its relatives, does not choose a shady spot; on the contrary, the favorite situation of *F. obscuripes* is in the middle of an open meadow, on some exposed railroad embankment, in fine, wherever the sun pours down its full measure of heat. The little squadron sallying forth to establish a new foundation no sooner discover a warm, sunny place, than they begin to dig a few holes in the soil, whence there arises gradually a little hill. At the same time straws, small twigs, dry blades of grass, and the like are zealously gathered by the indefatigable workers and, mixed with earth, are heaped on the hill. If the number of workers is considerable there arises

within a short time a domelike structure of variable dimensions up to 75 cm. in diameter and 40 cm. in height, bearing a resemblance to some of the famous Indian mounds abounding in this region. Still the nest has not yet its characteristic form, which seems to prove the most advantageous both for the adult individuals and especially for the undeveloped brood. The entrances are concentrated more and more in the central part of the dome surface. This surface is at first somewhat flattened, later on even hollowed out, so that under favorable circumstances the outer slopes of the hill appear entirely abandoned, so much so as to allow grass to cover them. Thereby, however, the nest is enclosed, as it were, by a massive rampart which proves an excellent protection against the extreme changes of temperature. By the same means, moreover, the ants succeed in hiding their nests to some degree, especially in spring time, when the new generation is being developed. Thus it may happen, that at this season the nests which are otherwise so conspicuous, may elude even a careful search. Of course in summer, after the grass is burned up by the sun, they are all the more noticeable. But at that time the ants are compelled by the excess of heat and want of humidity to retire to the lower compartments and ordinarily appear again only after a rain and on moderately warm days. Generally speaking, the main working season of our ants is in the early springtime. During summer and autumn they are found only

in the early morning hours and often not even then. Spring is also the only season in which we can count with certainty on securing guests of ants without extra trouble. Later in the year success is very doubtful, unless one happens, for instance, to strike the exact time when some of them, as *Xenodusa cava* Lec., effect a change of hosts.

Formica exsectoides For., easily recognizable by its shining abdomen and slightly concave occiput, is the second species which builds its formicary in the shape of a hill. But these hills are usually much lower and flatter. In any case they never approach in shape the truncated cones of *F. obscuripes*. Nor is there to be noticed so great a regularity in their structure. They sometimes resemble heaps of dirt dumped out at random. Besides, they consist for the most part of earth, although the latter is often mixed with vegetable remains. A favorite location of their nests seems to be some clearing in the brushwood. At least I found several nests on such spots and when, owing to frequent disturbances on my part, the ants preferred to change their domicile, they established their new dwelling in a precisely similar situation. The nest entrances are distributed without any apparent order. At any rate, they are not located merely "at the base and about the periphery." *Formica exsectoides* is one of the ants most frequently met with in this region, and often their colonies consist also here of ten and more nests.*

Whereas the two preceding species habitually build hills, they are to be found rarely or not at all with the following species. Thus they are rather rare with *Formica rubicunda* Em. and *Formica dakotensis* Em. The cause of this may be partly ascribed to their slaves, which generally do not construct real mounds. Of the two species just mentioned *F. rubicunda*, which may be easily recognized by its subsericea-abdomen, with almost unvarying constancy builds within and around the stumps of trees, which then present the following appearance. The remains of some sturdy oak are still standing firmly in the ground and are surrounded by leaves, twigs, etc. Merely a few entrances, which happen to exist in the trunk itself or have been constructed through the sod near the roots, establish communication with the interior. In such cases the use of explosives is almost unavoidable in order to lay bare the inner sanctum. Now and then the nests built by *rubicunda* are exceedingly similar to those of *F. subsericea*. This happens whenever the superior number of slaves exerts a greater influence on the structure of the nest. *Formica dakotensis*, on the contrary, finds its home usually under some flat stones and mostly so, as far as I could observe, when they have slaves. In the latter circumstances the nest presents the appearance as if two different "architects" had "evolved the plan." It is half

stinct to seize their enemies by the neck in order to saw it apart." According to my observation the analogy with their European congeners is complete also in this particular, so far as southwestern Wisconsin is concerned.

*By the way, Forel maintains to have ascertained that "unlike the exsecta of Europe these ants have not the in-

dakotensis, half *subsericea*. For the rest, if *F. dakotensis* has no slaves, it builds mounds often bearing a deceptive resemblance to those of *F. exsectoides*, as also at least their workers have some similarity with those of the latter, with the exception that their appearance is more delicate, the head being rounder, smaller and with less concavity of the occiput. Here too the slaves are, at least so far as may be determined from seven instances, in an inverse proportion to the number of the "lords."

The greatest irregularity of nest structure is to be noticed with *F. subsericea* Say, the auxiliary of *F. rubicunda* and *F. dakotensis*, active, fleet-footed, but cowardly, at least if alone. Yet notwithstanding the great variety, four principal kinds of nest structure may be distinguished. Passing along the edge of a forest, our attention may be suddenly arrested by a bare spot in the grass. At the same time there are to be noticed a number of apertures, through which the somewhat silky inmates effect an incredibly sudden retreat. This is one of their usual methods of nest construction. Another method not less characteristic is the one utilized now and then in the mixed colonies of *F. rubicunda* \simeq *subsericea* and *dakotensis* \simeq *subsericea*. On some slight elevation along the road arises an oblong, moderately sized hillock, topped by a piece of rock or a branch of a tree. The numerous entrances of the nest are all situated under this protecting roof, where during May and June may be found the queens

and cocoons which, however, disappear with marvellous rapidity upon the removal of their guardian portal. Moreover, mounds may be perceived here and there, but neither as large nor of the same shape as those of *F. obscuripes* and *F. exsectoides*. Finally, small colonies generally hide their establishments beneath stones.

Whilst the *subsericea*-nests, at least hereabouts, are never found in decaying logs, these are precisely the habitations of *Formica subaenescens* Em., so called from the appearance of its abdomen. When enslaved by *Polyergus bicolor* Wasm., which in consequence of its sickle-shaped mandibles is unable to excavate, they entirely determine the structure of the latter's nest. Yet it is not without interest to notice that these nests, as will be mentioned later on, with regard to some species of *Camponotus*, *Larius*, *Stenammas* etc., are in communication with the earth, whither their inmates retire during the extremes of cold and heat. Concerning the rather insignificant structures of the other five species occurring in this region, namely *F. pergandei* Em., *F. nitidiventris* Em., *F. fuscata* Em., *F. schaufussi* Mayr and *F. incerta* Em., it may suffice to remark, that they usually occur at the edge of fields or on hillsides, being ground nests and having their entrances under stones and logs.

In comparison, therefore, with the ants of Europe the exterior structure of American formicaries is somewhat insignificant, so that Forel justly avoided

calling them "mounds," at least as a general thing. But far different is the case with regard to the *inner structure*, which, *ceteris paribus*, is much more considerable. Wasmann defines a formicary as an "irregular aggregation of chambers and tunnels serving as the abode of ants and their brood and connected by different apertures with the outside world."* To characterize our ant-nests the following qualifications might be added to the above definition. In the first place, American nests descend to a relatively great depth. The part covered by fragments of woody material is but a small fraction of the dome. It is only in the case of *F. obscuripes*, that now and then not only the dome but also a considerable part of the nest itself consists of the above mentioned material. Below the dome the nest assumes gradually larger dimensions, until at a depth of 1.50 m. it often reaches a diameter of 2 m. and beyond. In a nest of *F. rubicunda* I found a few days before the first vernal oviposition ants in considerable numbers only at the depth of 1 m., a queen only at 1.25 m.† I had to penetrate to a like depth in the case of *F. exsectoides* and others. I examined one nest of *F. exsectoides* during November, when the ants had already retired to their winter quarters. Several hours were consumed in digging. After having reached a

depth of 2 m., I decided to desist. Most of the ants were found singly. Many were lying with their legs extended and embedded in the cold earth. It was only in the tunnels, which often follow the course of the roots, that we found clumps of ants as they are to be seen during winter in observation nests. One queen alone was captured; and yet it is well known that queens of *F. exsectoides* abound. Since we were concerned with a very populous nest, the principal part of it was necessarily still deeper down. Another peculiarity is to be found in the tunnels. Towards the surface they are highly concentrated; soon they separate further and further and being now horizontal now vertical, they penetrate into all parts of the nest. In the nest just mentioned, as also in some others, there were found at the depth of 1.50 m. directly below the dome only four irregular tunnels within a square meter.

A third characteristic feature, finally, is the preference manifested by the ants for stony locations. It is true that this is owing more to the character of the soil. But in virtue of their well developed faculty of adaptation, which is only a manifestation of their plastic instinct, these ants have been enabled to utilize this circumstance in an appropriate manner. For, the stones not only mean a great saving of work for the ants, but also impart great solidity to their structures. Moreover, they facilitate the regulation of temperature during spring, and in winter and summer such a rocky abode affords the best protection against

* E. Wasmann, S. J. Vergleichende Studien ueber das Seelenleben der Ameisen und der hoeheren Tiere. 2. Aufl. p. 67.

† Of course during the time of oviposition ♀s and ♂s may be found directly below the nest's surface.

heat and cold. To mention only one instance, a layer of 1 m. of stones and other hard material had to be penetrated, before reaching the real nest of *F. rubicunda*, which we examined carefully, and it was only at that depth in a sandy layer that the ants were found in greater abundance. The case was similar in nests of *F. exsectoides*, *F. dakotensis* and others.

Thus Prof. Forel's statement mentioned above has been found applicable also to this region. Besides it seems to be evident that the structure of more extensive domes is rendered useless by the extreme range of temperature varying from -20° F. to $+110^{\circ}$ F. (resp. $+150^{\circ}$ F. in the sun). For the development of the offspring the heat is sufficient even without domes, and during the warmest and coldest months such a dome would be uninhabitable. The theory that the nests of ants "abound above all on hill-slopes facing the east" (l. c. p. 232) has not been confirmed by my experience. For here ant-hills abound on eastern and western slopes alike.

NOTES. GALLS.—The large number of excellent photographic plates make Connold's British vegetable galls (New York: E. P. Dutton & Co., 1902, xii, 312 pp., 13 plates.

27 text figures) a work of considerable scientific interest. With their aid the abnormalities classified as galls, with the exception of those found on oak, that are common in Great Britain can be determined, and the identity or affinity of the British galls to those of North America especially commends the book to American students.

The text, in addition to faulty arrangement, contains many obscure and inaccurate statements.

GENERA INSECTORUM.—The scope of this work, which is due to the enterprise of Wytsman of Brussels, is shown by the first and second fascicules issued some months ago. In the first fascicule Régimhart deals with the Gyrinidae one of the most sharply defined families of the Coleoptera; he recognizes three tribes, nine genera, and 363 species. There are brief statements regarding the distribution, habitat, and characters of the family; analytical tables for the separation of the tribes and genera with more detailed characterization of the genera and lists of the species with the distribution of each. The plate, which is excellent, gives many structural details.

In the second fascicule Kieffer considers the Evaniidae, another easily distinguished family; the handling is similar to that of Régimhart though more open to criticism in some minor details; three subfamilies, nine genera, and 269 species are recognized.

Foeninae, *nom. nov.* is not tenable, Foenus Fab. (1798) being a synonym of Gasteruption Latr. (1796). Ashmead State Board of Agric., U. S. A. Catal. Ins. is not a very clear citation for Smith's List of New Jersey insects.

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